REMARKS

This paper is submitted in response to the Office Action mailed April 23, 2003. Following this amendment, claims 1-20 and 24 are pending. Claims 21-23 have been cancelled, claims 1, 3, 5-9, 12-14, and 16-18 have been amended, and claim 24 has been added as discussed below. Applicant submits that support for the amendments and new claim can be found throughout the specification and claims as originally filed. Thus, there is no new matter added as a consequence of the amendments or new claim. The amendments to the claims are made solely to clarify the claims and comply with U.S. practice. No narrowing in claim scope has occurred as a result of the amendments made herein.

Restriction Requirement

Applicant affirms the election of Group I, claims 1-20. Claims 21-23 of Group II have been cancelled without prejudice to continue the prosecution of the claims in a divisional application.

Objections to the Specification

The Examiner has objected to the abstract as applied to the claims 1-20.

To comply with U.S. practice, the abstract has been amended as requested by the Examiner.

New Claim

Claim 6 has been amended because it was a multiply dependent claim that improperly depended from a multiply dependent claim, i.e. claim 3. Claim 6 has been amended to depend

only from claim 1. New claim 24 has been added to incorporate the subject matter of claim 6 depending from claim 3.

The Rejections Under 35 U.S.C. § 112, Second Paragraph Should Be Withdrawn

Claims 1-20 are rejected under 35 U.S.C. § 112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Examiner indicates that claims 1, 9, 12 and 13 incorporate a narrow range within a broad range of limitation, which is considered indefinite. Specifically, claims 1, 9, 12 and 13 recite the broad limitation "rare earth metal" and the narrower limitation "having an atomic number of between 57 and 71."

The claims have been amended to delete the reference to "rare earth metal." In view of this amendment, applicant respectfully request withdrawal of the objection. To further clarify the claim, applicant has amended claims 1, 9, 12 and 13 to list all the elements having an atomic number between 57 and 71, inclusive. In support of this amendment, applicant submits the periodic table of the elements from an chemistry textbook to show the elements that fall within this group ("periodic table," Organic Chemistry, Wade, 2nd Edition, 1991, Prentice-Hall, Inc., Englewood Cliffs, NJ; attached as Exhibit 1).

The Examiner alleges that it is not clear whether the Ar unit is bonded to M in claims 1, 9, 12 and 13. Applicant respectfully traverses. The relevant inquiry is whether the formula expressed as "$M(Ar)(AlX_4)_3$" is indefinite for failing to particularly point out and distinctly claim the subject matter. This formula is well known to one of skill in the art as representing a

complex of an aluminum halide of a rare earth metal M in a solvent Ar. As evidence that this formula is well known and used conventionally in the art, applicant directs the Examiner's attention to EP 0637 589. (see Abstract; page 2, lines 26-29; page 3, lines 1-9; attached as Exhibit 2). As stated in the instant specification (page 2, line 18; page 3, line 21; page 5, line 20), Ar represents the aromatic hydrocarbon solvent of the complex. In response to the Examiner's query, Ar functions as a complexant agent, which can establish a weak interaction between the Nd and the solvent and who can at the same time serve to solubilize the complex.

The Examiner has indicated that the subscripts in the formula of claims 9, 12 and 13 were incorrect. Applicant thanks the Examiner for noticing this typographical error. These claims have been amended to correctly recite $M(Ar)(AlX_4)_3$, instead of $M(Ar)(AlX_3)$.

The Examiner has objected to claims 3, 7, 14 and 17, as reciting both a broad limitation "halogen atom" and a narrower limitation "fluorine, chlorine, bromine and iodine." Applicant has amended claims 3, 7, 14 and 17 to delete reference to "halogen." Claims 1, 9, 12, and 13 have been similarly amended. Withdrawal of the rejection of claims 3, 7, 14 and 17 is respectfully requested.

The Examiner has objected to claims 7, 8, 17 and 18 as reciting boron as a metal. In response, applicant has deleted "metal" from these claims. Withdrawal of the rejection of the claims is respectfully requested.

With regard to claims 14, 16 and 17, the Examiner indicates that it is not clear from which claims these claims depend. These claims have been amended to comply with U.S. practice. Withdrawal of the objection is respectfully requested.

The Office Action contends that in claims 14, 16, 19 and 20, it is not clear when in the processes the additional steps are to be performed. Applicant respectfully traverses. "Unless the

steps of a method actually recite an order, the steps are not ordinarily construed to require one." *Interactive Gift Express, Inc. v. Compuserve, Inc.* 256 F.3d 1323, 1342-43 (Fed. Cir. 2001) Here, applicant does not intend to restrict the order of the steps beyond that which is apparent from the claim language as currently drafted. Applicant submits that one or ordinary skill in the art, looking at the specification and claims would understand when the additional steps set forth in claims 14, 16, 19 and 20 may occur.

In paragraph nine of the Office Action, the Examiner has objected to various minor informalities. Claims 1, 3, 7, 9, 12, 13, 14, 17, and 18 have been objected to for the use of an improper Markush language. Claim 3 has been objected to for the use of an incorrect subscript. Claim 17 has been objected to for a typographical error. In response, the above referenced claims have been amended in accordance with the Examiner's suggestions.

The Examiner has requested the correction of a typographical errors in claims 9, 12 and 13. The claims have been amended to correct the errors.

The Examiner has objected to claim 14 for being unclear in the use of the phrase "may range from." The claim has been amended to recite "n is an integer ranging from 0 to 3, inclusive" which clearly sets forth that the range is from 0 to 3.

The Office Action contends that claim 7 is unclear due to the use the "$\in$" symbol after Z. Applicant disagrees and submits that the symbol "$\in$" is set membership notation, recognized by one of skill in the art (see "$\in$," Table of mathematical symbols, www. wikipedia.com, August 2, 2003, accessed Oct. 17, 2003, page 4; attached as Exhibit 5). As used in original claim 7, the skilled artisan would interpret the atomic number Z to mean that Z is member of the set comprising the following possible atomic numbers, 5, 13, 22, 26, 40, 50, 51, 72. To comply with U.S. practice, applicant has amended claim 7 to delete the use of the symbol and recite all

elements having an atomic number 5, 13, 22, 26, 40, 50, 51, 72, and from 51 and 57, inclusive, as a Markush group. Claim 17 has also been amended to conform with claim 7.

For the foregoing reasons, applicant submits that claims 1-20, as amended, are not indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. Applicant respectfully requests the withdrawal of the rejection of claims 1-20 under 35 U.S.C. § 112, second paragraph.

The Rejections under 35 U.S.C. § 103(a) Should Be Withdrawn

Claims 1-20 have been rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over Hu et al., Chinese Science Bulletin, vol. 37, pp. 566-570 ("Hu") in view of Jones et al., WO 92/17510 ("Jones"). The Examiner alleges that Hu discloses a catalyst that reads on the catalyst of the present claims, but admits that Hu does not disclose supporting the catalyst or a method of making the supported catalyst. The Examiner alleges that Jones discloses that lanthanide catalysts having pi-arene ligands as contained in Hu's catalyst may be supported on inorganic oxide supports as well as method of making such catalysts. The Examiner further alleges that it would have been obvious to one of skill in the art to apply the teaching of Jones to the disclosure of Hu to obtain a highly-useful diene polymerization catalyst and method of making it with the expected benefit of being able to use the catalyst in gas phase and slurry phase polymerizations. Applicant traverses the Examiner's rejections.

One of ordinary skill would not seek to combine the teachings of Jones with the disclosure of Hu, as Jones is directed towards catalysts used to polymerize olefins, while Hu is directed to homogeneous catalyst used to polymerize conjugated dienes. One of ordinary skill in the art would not seek to combine the teachings of supports used in the polymerization of olefins

when seeking to develop methods of polymerizing conjugated dienes using a solid supported catalyst.

The present invention is directed toward, *inter alia*, a solid supported catalyst for polymerization of conjugated dienes comprising the reaction product of (1) a solid support comprising an inorganic metal oxide compound and (2) a complex presented by the formula $M(Ar)(AlX_4)_3$ obtained from the reaction of a halide of rare earth metal and an aluminum halide in a solvent, as well as to processes for preparing the solid support catalyst. Hu discloses a catalyst for polymerizing a conjugated diene, isoprene. However, Hu discloses a homogeneous catalyst and does not disclose a supported catalyst. Nor does Hu teach or suggest the claimed methods of making a solid supported catalyst as set forth in the present invention.

One of ordinary skill in the art would not look to Jones to supply the missing claim limitations. Jones is primarily directed to olefin polymerization, not polymerization of conjugated dienes, as in the present invention. One of ordinary skill in the art is well aware that catalysts capable of polymerizing olefins are not able to polymerize dienes. Thus, the skilled artisan would not have looked to Jones for guidance. Since the cited art are directed to the polymerization of different polymers, one of skill in the art would not be motivated to combine the cited references.

In addition, there is no disclosure provided in Hu to apprise one of skill in the art of the need for a supported catalyst. Without such a teaching or suggestion of a need to modify Hu, there is no suggestion or motivation to combine the cited references in either reference so as to arrive at the claimed invention. Thus, for this additional reason, the combination of Hu and Jones does not render the claimed invention obvious.

Moreover, since there is no such suggestion or motivation, there is no reasonable expectation of success that using the support disclosed in Jones with the catalyst polymerizing an olefin in Hu would have produced the solid supported catalyst of the present invention. Such a combination would not, in fact, have been capable of polymerizing conjugated dienes having a content of cis-1,4 linkages higher than the polymer disclosed in Hu.

Hu discloses a homogeneous catalyst for polymerizing an olefin conjugated diene, isoprene. As explained in the present specification, a disadvantage of the homogeneous catalyst of Hu resides in undesired reduced viscosity values and undesired reduced cis-1,4 linkages in the resultant polyisoprene. (present specification, page 3, lines 1-12). Polymers obtained using the catalyst disclosed by Hu exhibit cis-1,4 linkages content of between 92.6% to 93.9% (see Hu, Tables 2-3) and a viscosity of 2.02 and 2.18 at 50 °C and 30 °C and only 0.73 at 70 °C (see Hu, Table 4).

In contrast, the conjugated dienes obtained using the catalyst of the present invention exhibit cis-1,4 linkages content of between 96.1% to above 99% (present specification, Examples 1-12) and an inherent viscosity as high as 6.5 dl/g at 60 °C (present specification, Example 5). Thus, the catalyst of the present invention clearly performs better than the catalyst disclosed by Hu. One of ordinary skill in the art, looking at the disclosures of Hu and Jones, would not have any expectation of success of arriving at the catalyst of the present invention.

For the foregoing reasons, applicant submits that claims 1-20 are not obvious and patentable Hu in view of Jones. Applicant respectfully requests the withdrawal of the rejection of claims 1-20 under 35 U.S.C. § 103(a).

CONCLUSION

In view of the foregoing amendments and remarks, Applicant respectfully requests withdrawal of the outstanding rejections and allowance of the pending claims.

Applicant requests a three month extension of time and encloses herewith the requisite fee as set forth in 37 C.F.R. § 1.17(a)(3). Applicant does not believe that any additional fee is required in connection with the submission of this document. However, should any fee be required, or if any overpayment has been made, the Commissioner is hereby authorized to charge any fees, or credit or any overpayments made, to Deposit Account 02-4377. A duplicate copy of this sheet is enclosed.

Respectfully submitted,
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PERIODIC TABLE OF THE ELEMENTS

Period	Group IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIIIB			IB	IIB	IIIA	IVA	VA	VIA	VIIA	Noble gases
1	1 Hydrogen H 1.00797																	2 Helium 4.
2	3 Lithium Li 6.939	4 Beryllium Be 9.0122											5 Boron B 10.811	6 Carbon C 12.011	7 Nitrogen N 14.0067	8 Oxygen O 15.9994	9 Fluorine F 18.9984	10 Neon Ne 20.183
3	11 Sodium Na 22.9898	12 Magnesium Mg 24.312											13 Aluminum Al 26.9815	14 Silicon Si 28.086	15 Phosphorus P 30.9738	16 Sulfur S 32.064	17 Chlorine Cl 35.453	18 Argon Ar 39.944
4	19 Potassium K 39.102	20 Calcium Ca 40.08	21 Scandium Sc 44.956	22 Titanium Ti 47.90	23 Vanadium V 50.942	24 Chromium Cr 51.996	25 Manganese Mn 54.938	26 Iron Fe 55.847	27 Cobalt Co 58.933	28 Nickel Ni 58.71	29 Copper Cu 63.54	30 Zinc Zn 65.37	31 Gallium Ga 69.72	32 Germanium Ge 72.60	33 Arsenic As 74.922	34 Selenium Se 78.96	35 Bromine Br 79.916	36 Krypton Kr 83.80
5	37 Rubidium Rb 85.447	38 Strontium Sr 87.62	39 Yttrium Y 88.905	40 Zirconium Zr 91.22	41 Niobium Nb 92.906	42 Molybdenum Mo 95.94	43 Technetium Tc (98)	44 Ruthenium Ru 101.07	45 Rhodium Rh 102.905	46 Palladium Pd 106.4	47 Silver Ag 107.870	48 Cadmium Cd 112.40	49 Indium In 114.82	50 Tin Sn 118.69	51 Antimony Sb 121.75	52 Tellurium Te 127.60	53 Iodine I 126.904	54 Xenon Xe 131.30
6	55 Cesium Cs 132.905	56 Barium Ba 137.34	* 57 Lanthanum La 138.91	72 Hafnium Hf 178.49	73 Tantalum Ta 180.948	74 Wolfram (Tungsten) W 183.85	75 Rhenium Re 186.20	76 Osmium Os 190.2	77 Iridium Ir 192.2	78 Platinum Pt 195.09	79 Gold Au 196.967	80 Mercury Hg 200.59	81 Thallium Tl 204.37	82 Lead Pb 207.19	83 Bismuth Bi 208.980	84 Polonium Po (210)	85 Astatine At (210)	86 Rad Rn (222)
7	87 Francium Fr (223)	88 Radium Ra (226)	† 89 Actinium Ac (227)	104 Unnilquadium Unq (261)	105 Unnilpentium Unp (262)	106 Unnilhexium Unh (263)												

*Lanthanide series	58 Cerium Ce 140.12	59 Praseodymium Pr 140.907	60 Neodymium Nd 144.24	61 Promethium Pm (147)	62 Samarium Sm 150.35	63 Europium Eu 151.96	64 Gadolinium Gd 157.25	65 Terbium Tb 158.924	66 Dysprosium Dy 162.50	67 Holmium Ho 164.930	68 Erbium Er 167.26	69 Thulium Tm 168.934	70 Ytterbium Yb 173.04	71 Lutetium Lu 174.97
†Actinide series	90 Thorium Th 232.038	91 Protactinium Pa (231)	92 Uranium U 238.03	93 Neptunium Np (237)	94 Plutonium Pu (242)	95 Americium Am (243)	96 Curium Cm (247)	97 Berkelium Bk (249)	98 Californium Cf (251)	99 Einsteinium Es (254)	100 Fermium Fm (253)	101 Mendelevium Md (256)	102 Nobelium No (253)	103 Lawrencium Lr (257)

6 Carbon C 12.011 — Atomic number, Name, Symbol, Atomic weight[a]

[a] Numbers in parentheses are mass numbers of the most stable or best-known isotope of radioactive elements.

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A computer-generated section of a DNA molecule; blue indicates nitrogen; white, carbon; red, oxygen; and yellow, phosphorus. The image is courtesy of Evans and Sutherland Computer Corporation.

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